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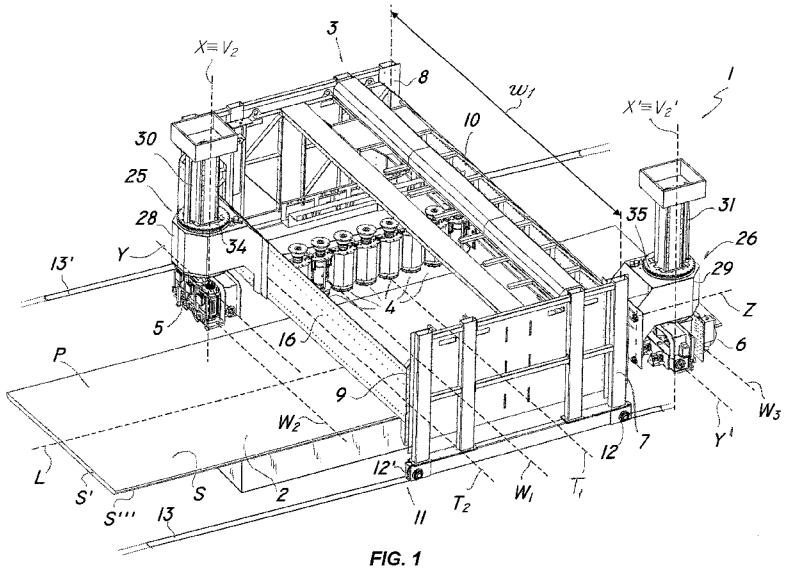


FIG. 1

(57) Abstract: A multi-tool machine for processing products (P) made of stone materials to be processed, comprising a support surface (2) extending along a longitudinal axis (L) for supporting one or more products (P), a bearing structure (3) designed for translation along the longitudinal axis (L) and adapted to support at least one first (4), one second (5) and one third (6) processing heads, which are designed for interaction with one or more surfaces (S, S\ S", S"') of the product (P). The first (4), second (5) and third (6) processing heads are movable relative to the bearing structure (3) independently of the others for simultaneous processing of multiple surfaces (S, S\ S", S"') of the product (P).

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# MULTI-TOOL MACHINE FOR PROCESSING PRODUCTS MADE OF STONE MATERIALS

## Field of the invention

**[0001]** The present invention generally finds application in the field of processing of materials with high surface hardness, and particularly relates to a multi-tool machine for processing products made of stone, cementitious materials, conglomerates, granites and the like.

## Background art

**[0002]** Products made of high-hardness materials are known to be processed using one or more tools for providing particular processing on one or more surfaces of the product.

**[0003]** Particularly, machines are known for providing surface processing such as honing, polishing, scratching, drilling and brushing of one or more surfaces of the product.

**[0004]** Furthermore, the products to be processed may be either blocks of stone material or granite, or prefabricated panels made of concrete, conglomerates or other similar materials.

**[0005]** A common type of machines uses a single processing head, which is movable above one or more surfaces of the products to be processed.

**[0006]** Nevertheless, these machines have relatively long product processing times and require frequent operator interventions.

**[0007]** Multiple processing on the surface of the product requires the head to be stopped from time to time for tool replacement.

**[0008]** In an attempt to obviate this drawback, machines or plants for processing products made of stone or stone-like materials have been provided, which have a plurality of movable heads for carrying out respective surface processing operations on one or more sides of the product.

**[0009]** FR2694720 discloses a device for surface treatment of slabs of stone or cementitious materials, comprising a pair of longitudinal bridge beams slidably mounted to a pair of transverse rails.

**[0010]** These beams support a longitudinally movable cross member, comprising a central processing head and a pair of lateral heads.

**[0011]** Particularly, all the heads are vertically movable, with the lateral heads also having additional differentiated and independent axes of movement.

**[0012]** Thus, the device may perform multiple simultaneous processing operations by simultaneous interaction of the tools of each head with the surface to be processed.

**[0013]** Nevertheless, this device affords limited improvements, as it can only perform a small number of types of processing operations, and only perceivably reduces the overall product processing times.

**[0014]** This is because the presence of a single transverse beam limits the independent movement of the heads, particularly in longitudinal directions.

**[0015]** Therefore, simultaneous processing by all the heads may only occur over a small longitudinal portion of the upper surface of the product.

**[0016]** Furthermore, the fixed inclination of one of the heads allows no processing that requires differentiated clearance angles of the tool relative to the surface of the product.

**[0017]** Also, any processing that requires the tool to be rotated along a vertical axis substantially orthogonal to the plane of the product surface, such as honing, polishing or brushing, may be only simultaneously performed by the central head and one of the lateral heads, which will increase the overall time required by such processing.

**[0018]** Another serious drawback of this arrangement is that the maximum rotation angle of the hinged lateral head about a longitudinal axis of rotation is a straight angle, which doesn't allow the tool to process the lower surface of the object to be processed.

## Disclosure of the invention

**[0019]** The object of the present invention is to overcome the above drawbacks, by providing a multi-tool machine for processing products made of stone or stone-like materials, that is highly efficient and relatively cost-effective.

**[0020]** A particular object of the present invention is to provide a multi-tool

machine for processing products made of stone or stone-like materials that can considerably reduce the overall time required for processing the semifinished product.

**[0021]** A further object of the present invention is to provide a multi-tool machine for processing products made of stone or stone-like materials that allows a plurality of processing operations, not necessarily surface processing operations, to be simultaneously performed on the product to be processed.

**[0022]** Another object of the present invention is to provide a multi-tool machine for processing products made of stone materials that is particularly flexible and can provide a wide range of processing operations without limitation, in a single processing cycle.

**[0023]** Yet another object of the present invention is to provide a multi-tool machine for processing products made of stone materials that can easily and quickly process the borders or edges of the semifinished product.

**[0024]** These and other objects, as better explained hereafter, are fulfilled by a multi-tool machine for processing products made of stone or stone-like materials as defined in claim 1.

**[0025]** Advantageous embodiments of the invention are obtained in accordance with the dependent claims.

## Brief description of the drawings

**[0026]** Further features and advantages of the invention will be more apparent upon reading of the detailed description of a preferred, non-exclusive embodiment of a multi-tool machine for processing products made of stone materials or the like according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is a perspective view of a multi-tool machine of the invention;

FIG. 2 is a top view of the machine of Fig. 1;

FIG. 3 is a broken-away lateral view of the machine of Fig. 1;

FIGS. 4 and 5 are front views of first and second enlarged details of Fig. 3;

FIG. 6 is a first lateral view of the machine of Fig. 1;

FIG. 7 is a second lateral view of the machine of Fig. 1;

FIGS. 8 to 10 are front views of a third detail of Fig. 1 in different operating positions;

FIGS. 11 and 12 are lateral views of the third detail of Fig. 1.

Detailed description of a preferred embodiment

**[0027]** With reference to the above-mentioned figures a multi-tool machine is shown for processing products made of stone materials, generally designated by numeral 1, which is designed to provide processing of one or more surfaces S, S', S", S"' of the product P to be processed.

**[0028]** Particularly, the machine 1 may be used for processing of stone or granite blocks or slabs, or for processing of prefabricated slabs or panels made of concrete, conglomerates or other similar materials.

**[0029]** The multi-tool machine 1 comprises a support surface 2 defining a longitudinal axis L for supporting one or more products P to be processed and a bearing structure 3 designed for translation along the longitudinal axis L and adapted to support at least one first 4, at least one second 5 and at least one third 6 processing heads, which are designed for interaction with one or more surfaces S, S', S", S"' of the product P to be processed.

**[0030]** Particularly, the support surface 2 may be located at a predetermined height from the ground for raised positioning of one or more slabs be processed or small-size stone products P.

**[0031]** Otherwise, the support surface 2 may coincide with the ground G for processing relatively large blocks or products P.

**[0032]** According to a peculiar configuration of the invention, the first 4, second 5 and third 6 processing heads 6 are movable relative to the bearing structure 3 independently of one another for simultaneous processing of one or more surfaces S, S', S", ... of the product P being processed.

**[0033]** Thus, the same multi-tool machine 1 may be used for performing a plurality of processing operations on the surfaces S, S', S", ... of the product P, not necessarily one after the other, thereby considerably reducing the overall processing times.

**[0034]** Conveniently, as better shown in the figures, the first 4, second 5

and third 6 heads may be independently movable along respective substantially horizontal transverse translational directions $W_1$, $W_2$, $W_3$.

**[0035]** The bearing structure 3 may have a bridge construction and comprise a pair of substantially vertical posts 7, 8, joined together by at least one pair of transverse beams 9, 10.

**[0036]** The beams 9, 10 may be longitudinally spaced and the machine 1 may comprise longitudinal guide means 11 secured to the ground G for longitudinal translation of the bearing structure 3 relative to the support surface 2.

**[0037]** Also, the bearing structure 3 may be adapted to prevent independent longitudinal displacement of the first 4, second 5 and third 6 heads.

**[0038]** Thus, as better shown in the figures, the longitudinal translation of the bearing structure 3 will cause simultaneous longitudinal movement of the first 4, second 5 and third 6 heads in the same direction of displacement.

**[0039]** Conveniently, the beams 9, 10 may have a predetermined transverse length $w_1$ which will depend on the maximum width of the products being processed.

**[0040]** For example, the beams 9, 10 may have a transverse length $w_1$ of not less than 2200 mm.

**[0041]** The longitudinal guide means 11, as best shown in FIG. 1, may be also associated with the posts 7, 8 of the bearing structure 3.

**[0042]** Particularly, the longitudinal guide means 11 may comprise, for each post 7, 8, a pair of first wheels 12, 12' which are adapted for sliding engagement on respective longitudinal first rails 13, 13' secured to the surface G upon which the structure 3 is supported.

**[0043]** Furthermore, the first rails 13, 13' may have a longitudinal length equal to or greater than the maximum length of the products P to be processed.

**[0044]** The machine 1 may comprise longitudinal drive means, not shown, for driving the first wheels 12, 12' into controlled rotation on the first rails 13, 13' and allow displacement of the posts 7, 8 relative to the support

surface 2.

**[0045]** Conveniently, the beams 9, 10 may comprise a pair of mutually facing inner walls 14, 15 and a pair of outer walls 16, 17 facing away from the inner walls 14, 15 and outside of the bearing structure 3.

**[0046]** Conveniently, as best shown in FIGS. 2 and 3, the machine 1 may comprise first transverse guide means 18 associated with the inner walls 14, 15 of the pair of beams 9, 10 for slidably guiding a first carriage 19 which is adapted to support at least one first processing head 4.

**[0047]** The first transverse guide means 18 may be adapted to allow the first carriage 19 to move in a first transverse translational direction $T_1$ parallel to or coincident with the respective translational direction $W_1$ of the first heads 4.

**[0048]** Particularly, the first transverse guide means 18 may comprise a pair of second wheels 20, 20' associated with the first carriage 20 and adapted for slidable engagement on respective second rails 21, 21' secured to the inner walls 14, 15 of the beams 9, 10.

**[0049]** The machine 1 may comprise first transverse drive means, not shown, operable on the first carriage 19, for driving the second wheels 20, 20' into rotation on the second rails 21, 21'.

**[0050]** The first head 4 may comprise at least one tool U adapted for interaction with the upper surface S of the product P being processed.

**[0051]** P articularly, the tool U of the first head 4 may be movable in a first translational direction $V_1$ substantially vertical relative to the first carriage 19.

**[0052]** Particularly, as best shown in FIGS. 3, 4 and 5, the first head 4 may comprise first linear actuators 22 associated with the tool U for causing its vertical translational movement in the first translational direction $V_1$.

**[0053]** Particularly, each linear actuator 22 may be designed to cause the tool U to vertically move through a stroke of not less than 100 mm.

**[0054]** Furthermore, the machine 1 may comprise a plurality of first heads 4 mounted to the first carriage 19 in longitudinal side-by-side relationship.

**[0055]** The number of the first heads 4 may be selected to allow simultaneous processing of the entire width of the upper surface S of the

product P.

**[0056]** In the illustrated configuration, which shall be intended as a non-limiting example of the present invention, the machine 1 comprises eight adjacent first processing heads 4 mounted to the first carriage 19 and adapted to allow simultaneous processing of an upper surface having a width of not less than 2200 mm.

**[0057]** Advantageously, the first heads 4 may be independently movable in respective first vertical translational directions $V_1$.

**[0058]** Due to this feature, the first heads 4 may allow their respective tools U to be placed at the same distance d from the upper surface S or at different distances d, to provide a plurality of processing operations of the same or different types on the surface S.

**[0059]** For example, the plurality of first heads 4 may be designed for simultaneously carrying out honing, polishing, brushing, scratching, grooving and drilling processes on the upper surface letter S of the product P.

**[0060]** Conveniently, the machine 1 may comprise second 23 and third 24 transverse guide means, as best shown in FIGS. 6 and 7, associated to respective outer walls 16, 17 of the beams 9, 10 for slidably guiding a second carriage 24 adapted to support at least a second head 5 and a third carriage 26 adapted to support at least a third head 6 respectively.

**[0061]** The second 5 and/or third 6 heads may comprise additional tools U adapted for interaction with one of the surfaces S, S',S", ... of the product P being processed.

**[0062]** The machine 1 may comprise second and third drive means, not shown, associated with the second 25 and third 26 carriages for causing their controlled translational movement in respective transverse translational directions $T_2$, $T_3$.

**[0063]** Also, the second 23 and third 24 transverse guide means may be designed to allow translation of the second 25 and third 26 carriages through a stroke as long as or smaller than the transverse length of the beams 9, 10.

**[0064]** The second 23 and third 24 transverse guide means may comprise a plurality of bushings, not shown, associated with the second 25

and third 26 carriages and adapted for slidable engagement of respective transverse rails 27, as shown in FIG. 7, integral with the outer wall 16, 17 of the beam 9, 10.

**[0065]** For example, the second 23 and third transverse guide means 24 may be selected from the group comprising recirculating-ball or roller screws or the like.

**[0066]** Conveniently, as clearly shown in FIGS. 1 and 6, the second 25 and third 26 carriages may be mounted in cantilever fashion to respective outer walls 16, 17 of the beams 9, 10.

**[0067]** Also, the second 25 and third 26 carriages may comprise respective extensions 28, 28 having slides 30, 31 associated thereto for supporting and slidably guiding the second processing head 5 or the third processing head 6.

**[0068]** The extensions 28, 29, as best shown in FIGS. 6 to 12, may comprise a substantially vertical central passage 32, 33 for receiving the slide 30, 31.

**[0069]** Conveniently, the extensions 28, 29 may comprise respective supports 34, 35 for slidably guiding the slides 30, 31 for translation thereof along respective second vertical translational directions $V_2$, $V_2$'.

**[0070]** For example, the supports 34, 35 may be designed to cause translation of each slide 30, 31 in the second vertical translational direction $V_2$, $V_2$' through a stroke of not less than 300 mm.

**[0071]** Also, each support may be rotatably mounted to the extension 32, 33 for rotation of the slides 30, 31 about respective vertical axes of rotation X, X' coincident with or parallel to the second translational directions $V_2$, $V_2$'.

**[0072]** In the configuration of the invention as shown in the figures, each slide 30, 31 rotates about a vertical axis of rotation X, X' which coincides with the respective second translational direction $V_2$, $V_2$'.

**[0073]** Particularly, each slide 30, 31 may rotate about its own vertical axis X, X' with a maximum rotation angle close to a round angle.

**[0074]** Furthermore, the second 25 and third 26 carriages comprise respective first motor means, not shown, associated with the supports 34, 35

and adapted to cause both controlled vertical translation of the slide 30, 31 and controlled rotation thereof about the vertical axis of rotation X, X'.

**[0075]** Particularly, the first motor means may comprise a linear motor, not shown, or other similar devices.

**[0076]** Of course, the controlled movement of the slide 30, 31 will cause a corresponding translation of the second 5 or third 6 heads in the second translational direction $V_2$, $V_2$' or rotation thereof about the first vertical axis of rotation X, X'.

**[0077]** Conveniently, the second 5 and/or third 6 heads may be rotatable about a respective substantially horizontal first axis of rotation Y, Y'.

**[0078]** Particularly, the first axis of rotation Y, Y' may be a substantially transverse axis.

**[0079]** Particularly, the maximum rotation of the second head 5 and the third head 6 about respective transverse axes of rotation Y, Y' may be substantially close to or slightly smaller than a round angle.

**[0080]** Furthermore, the second 25 and third 26 carriages may comprise respective second motor means, not shown, which are adapted to drive the second 5 and third 6 heads into controlled rotation about corresponding axes of rotation Y, Y'.

**[0081]** Advantageously, at least one of the second 5 and third 6 processing heads may pivot about a substantially horizontal second transverse axis of rotation Z through a predetermined maximum angular range $\Delta\theta$.

**[0082]** Particularly, the second axis of rotation Z may be a substantially longitudinal axis.

**[0083]** For instance, the second 5 and/or third 6 heads may pivot about the corresponding second transverse axis of rotation Z through a maximum angular stroke $\Delta\theta$ of about 200°.

**[0084]** Conveniently, the second transverse axis of rotation Z may be substantially orthogonal to the first transverse axis of rotation Y, Y'.

**[0085]** The second 25 and/or third 26 carriages may comprise respective third motor means, not shown, which are adapted to drive the second 5

and/or third 6 heads into controlled rotation about the second transverse axis of rotation Z.

**[0086]** Thus, by synchronized driving of the first, second and third motor means, the position of the second 5 and/or third 6 heads relative to the support surface 2 may be changed, for the tools U thereof to interact with any surface S, S', S",... of the product P being processed.

**[0087]** Furthermore, the second 5 and third 6 heads may be positioned relative to the support surface 2 such that the tools U interact with one of the surfaces S, S', S", ... to be processed in an inclined position relative to the vertical and/or the horizontal.

**[0088]** For example, as shown in FIGS. 8, 9 and 10, the motor means may position the second 5 and/or third 6 heads such that the tool U can interact with the lateral surfaces S', S" or the lower surface S"' of a slab or with the borders thereof to carry out processing operations such as honing, polishing, brushing, scratching, grooving or the like.

**[0089]** Conveniently, as best shown in FIGS. 7 to 12, each slide 30, 31 may have one end 38, 39 connected to a fork bracket 40, 41 for supporting the second 5 or third 6 processing heads.

**[0090]** Particularly, the second 5 and/or third 6 heads may be mounted to the fork bracket 40, 41 through a pair of rotating joints, one of which, referenced 42, is only visible in the figures, for causing rotation thereof about the first transverse axis of rotation Y, Y'.

**[0091]** Conveniently, the second 5 and/or third 6 heads may comprise a substantially vertical support plate 43 for supporting at least one tool Y and a substantially horizontal support 44 for supporting at least one additional tool U.

**[0092]** This arrangement of the tools Y adds flexibility to the heads 5, 6, as a plurality of tools U may be accommodated, for providing different processing operations on the surface S, S', S", S"' of the product P.

**[0093]** For instance, as best shown in FIGS. 11 and 12, the second 5 and/or third 6 heads may comprise three tools U supported by the vertical plate 43, i.e. a pair of drilling spindles 45 and a cutting disk 46, and three

additional tools U supported by the horizontal plate 44 for carrying out surface processing such as honing, polishing, brushing or the like.

**[0094]** The above disclosure clearly shows that the invention fulfills the intended objects and particularly meets the requirement of providing a multi-tool machine for processing products made of stone or stone-like materials that allows simultaneous interaction of multiple tools with the surfaces of a product, thereby considerably reducing the overall processing times.

**[0095]** The multi-tool machine of the invention is susceptible of a number of changes and variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

**[0096]** While the multi-tool machine has been described with particular reference to the accompanying figures, the numerals are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

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## CLAIMS

1. A multi-tool machine for processing products (P) made of stone or stone-like materials, comprising a support surface (2) for one or more products (P) to be processed, which defines a longitudinal axis (L), a bearing structure (3) designed for translation along said longitudinal axis (L) and adapted to support at least one first (4), one second (5) and one third (6) processing heads, which are designed for interaction with one or more surfaces (S, S', S", S'") of the product (P) being processed,

wherein each of said heads (4, 5, 6) is movable relative to said bearing structure (3) independently of the others for simultaneous processing of multiple surfaces (S, S', S", S'") of each product (P) being processed;

characterized in that said bearing structure (3) has a bridge construction with at least one pair of substantially vertical posts (7, 8) joined together by at least one pair of substantially parallel transverse beams (9, 10), with mutually facing inner walls (14, 15) and outer walls facing outside of said bearing structure (3).

2. A machine as claimed in claim 1, characterized in that each of said heads (4, 5, 6) is movable in a respective substantially horizontal and transverse direction (W1, W2, W3).

3. A machine as claimed in claim 1, characterized in that each of said beams (9, 10) comprises first transverse guide means (18) associated with said inner walls (14, 15) for slidably guiding a first carriage (19) which is adapted to support at least one first processing head (4).

4. A machine as claimed in claim 1, characterized in that said at least one first head (4) comprises at least one tool (U) adapted for interaction with the upper surface (S) of the product (P) being processed.

5. A machine as claimed in claim 3, characterized in that said first carriage (19) supports a plurality of first processing heads (4) in longitudinally offset positions, each of said first heads (4) being movable in a substantially vertical translational direction ($V_1$) independently of the others.

6. A machine as claimed in claim 3, characterized in that each of said beams (9, 10) comprises second (23) and third (24) transverse guide means

associated with said outer walls (16, 17) for slidably guiding a second carriage (25) adapted to support said at least one second processing head (5) and a third carriage (26) adapted to support said at least one third processing head (6) respectively.

7. A machine as claimed in claim 6, characterized in that said second (25) and said third (26) carriages comprise each one extension (28, 29) having a slide (30, 31) associated therewith, for supporting and slidably guiding said at least one second processing head (5) or said at least one third processing head (6) in a substantially vertical translational direction ($V_2$, $V_2$').

8. A machine as claimed in claim 7, characterized in that each of said slides (30, 31) is slidably guided by a support (34, 35) which is rotatably mounted to said extension (28, 29) to rotate about a respective substantially vertical axis of rotation (X, X').

9. A machine as claimed in claim 7, characterized in that said at least one second head (5) and/or said at least one third head (6) are rotatable about a respective substantially horizontal first axis of rotation (Y, Y').

10. A machine as claimed in claim 7, characterized in that at least one of said second (5) and said third (6) processing heads are oscillating about a respective substantially horizontal second transverse axis of rotation (Z) by a predetermined maximum angular range ($\Delta\theta$).

11. A machine as claimed in claim 6, characterized in that said at least one second (5) and/or said at least one third (6) processing heads comprise at least one substantially vertical supporting plate (43) and at least one substantially horizontal supporting plate (44) for supporting each at least one respective processing tool (U).

12. A machine as claimed in claim 1, characterized in that it comprises longitudinal guide means (11) adapted to be secured to the ground (G) for slidably guiding said posts (7, 8) in said longitudinal direction (L) relative to said support surface (2).

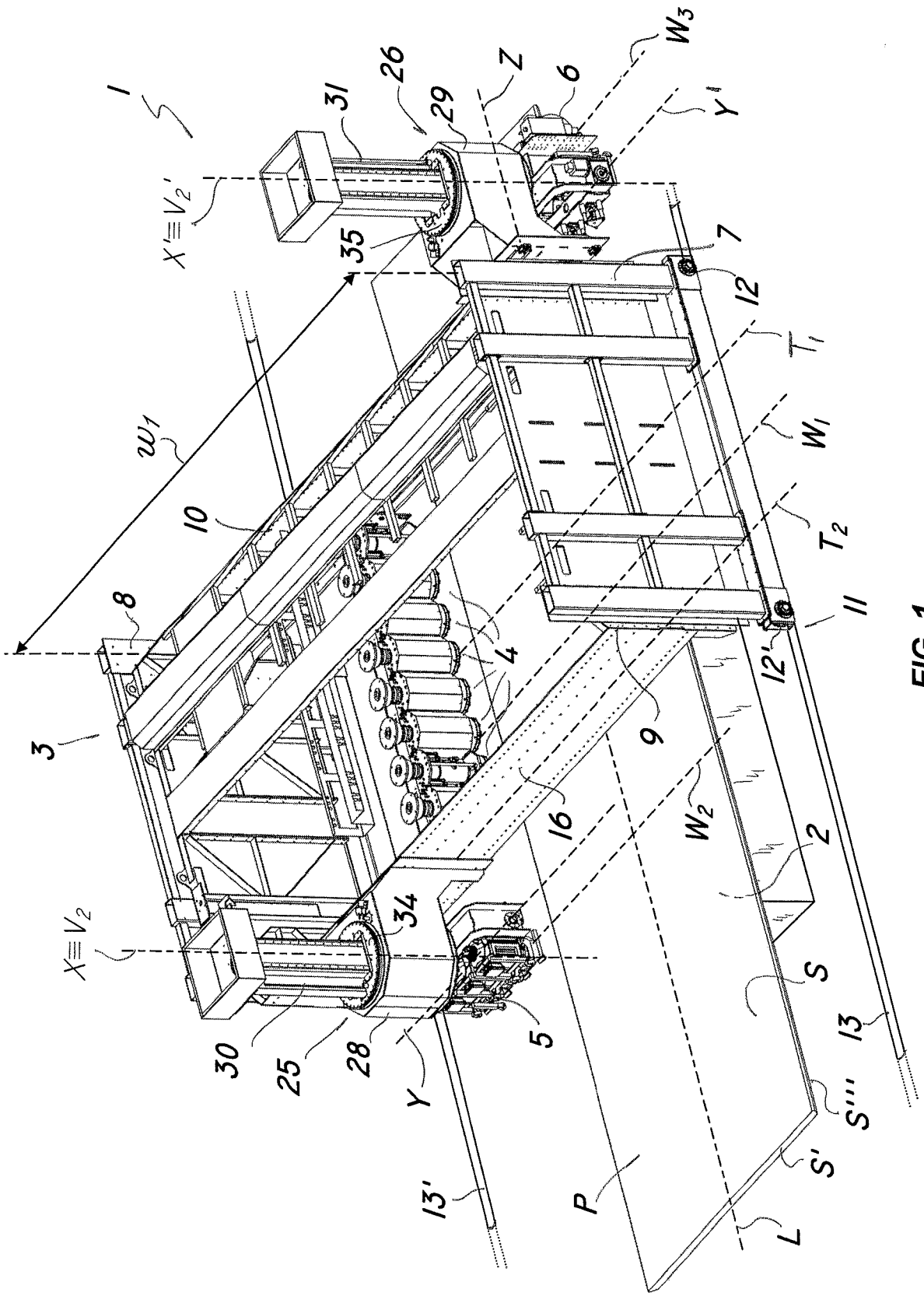
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FIG. 1

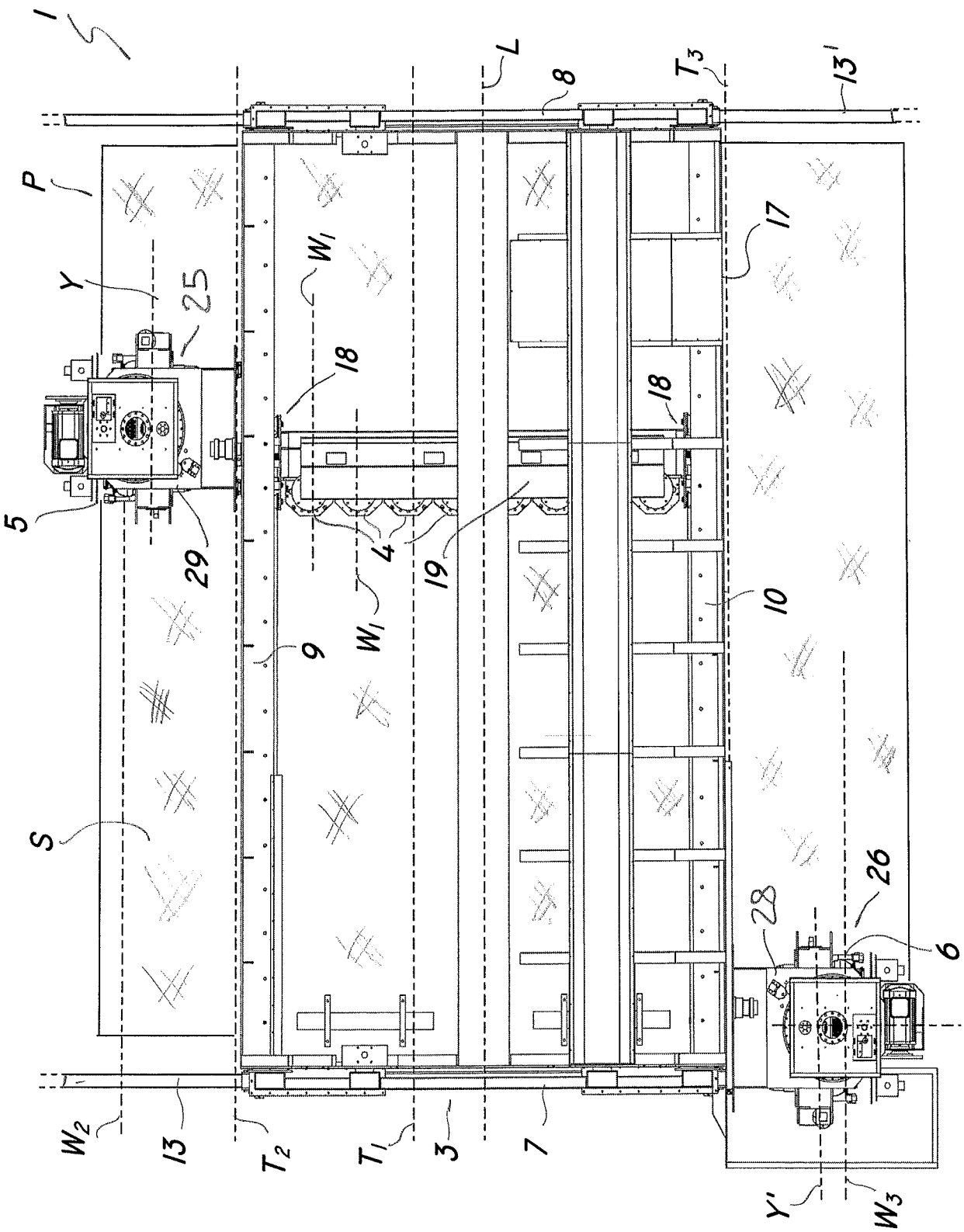



FIG. 2

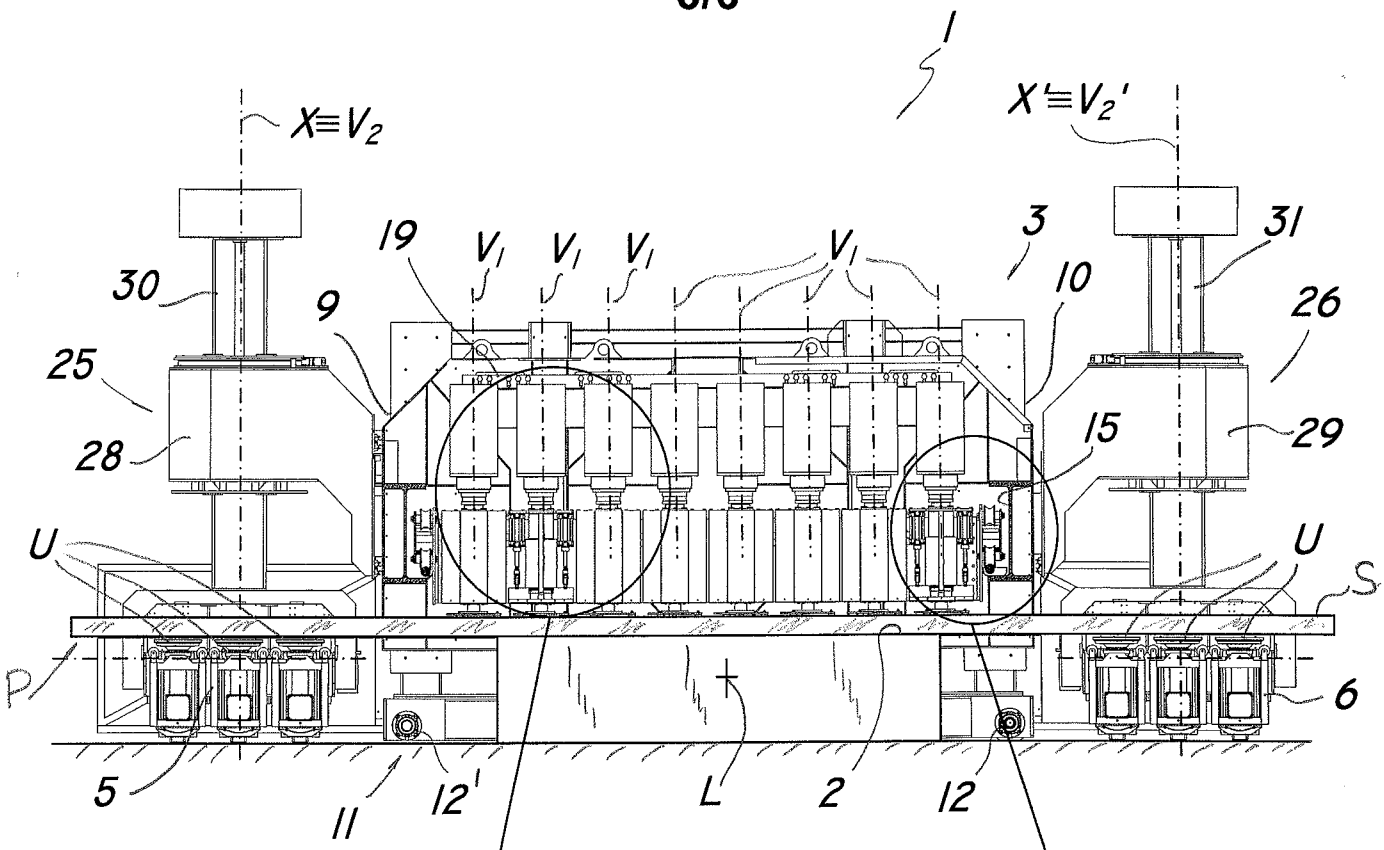



FIG. 3

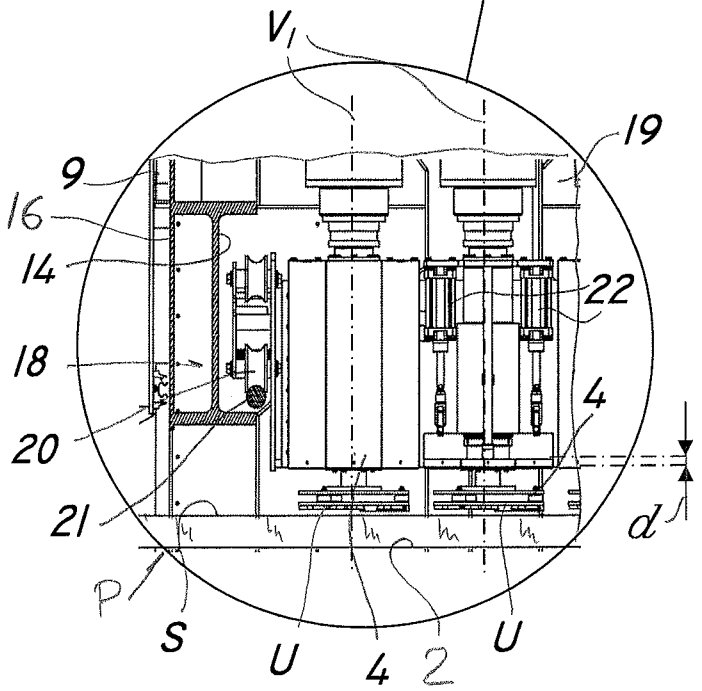



FIG. 4

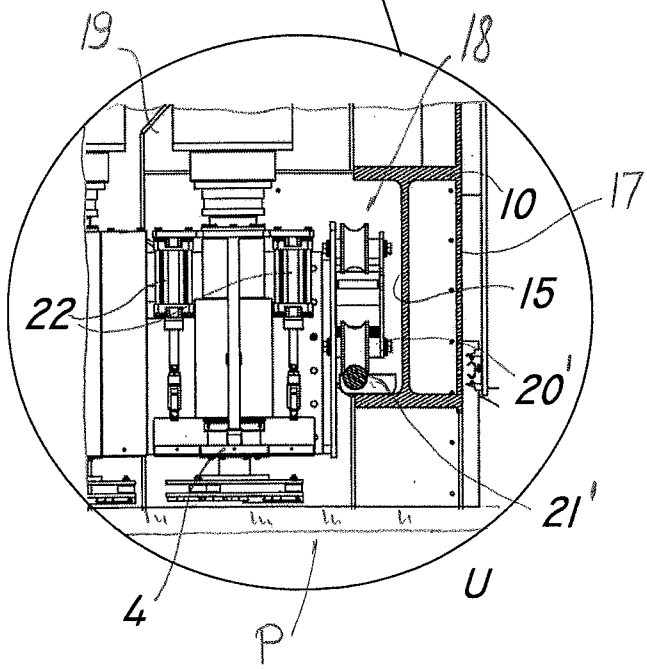
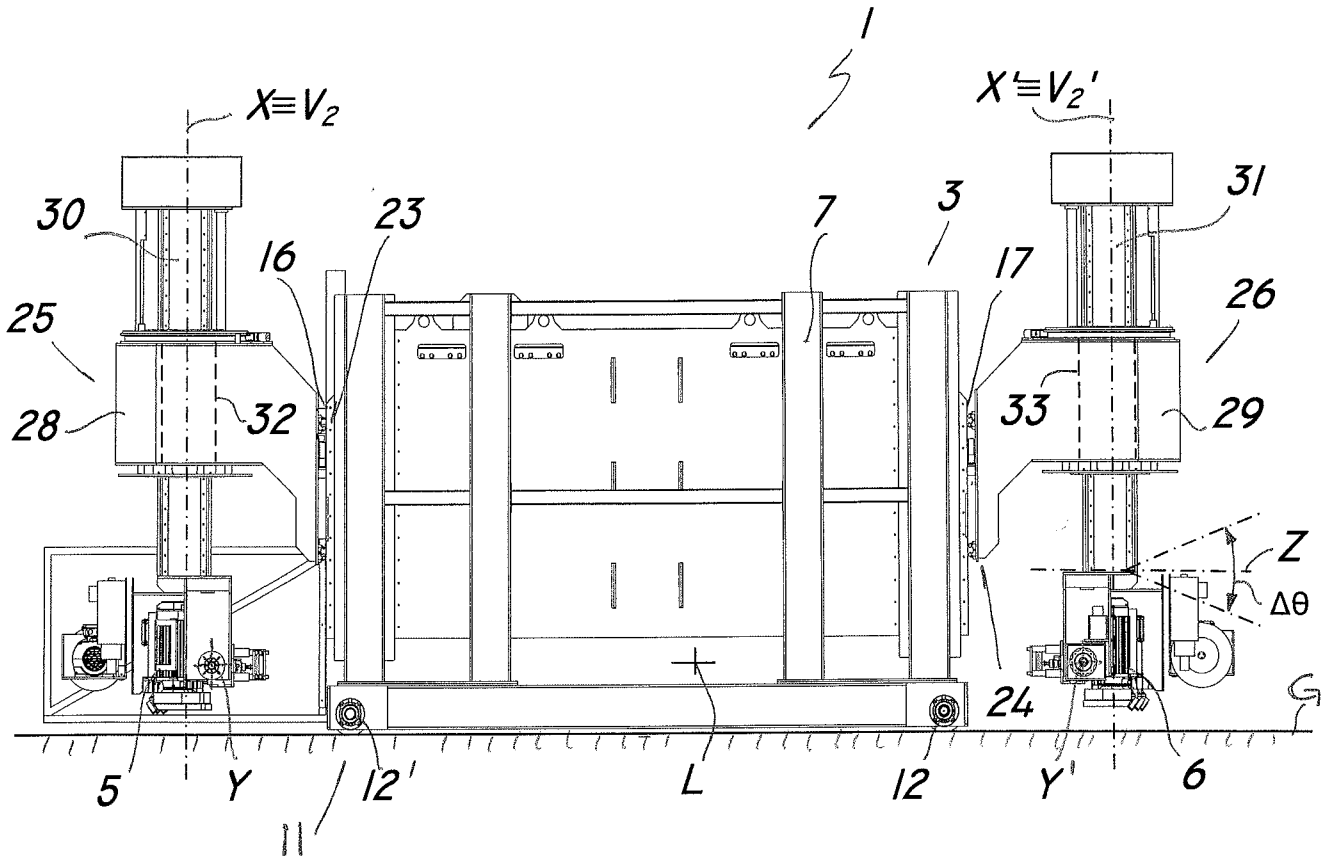



FIG. 5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6
11

FIG. 6

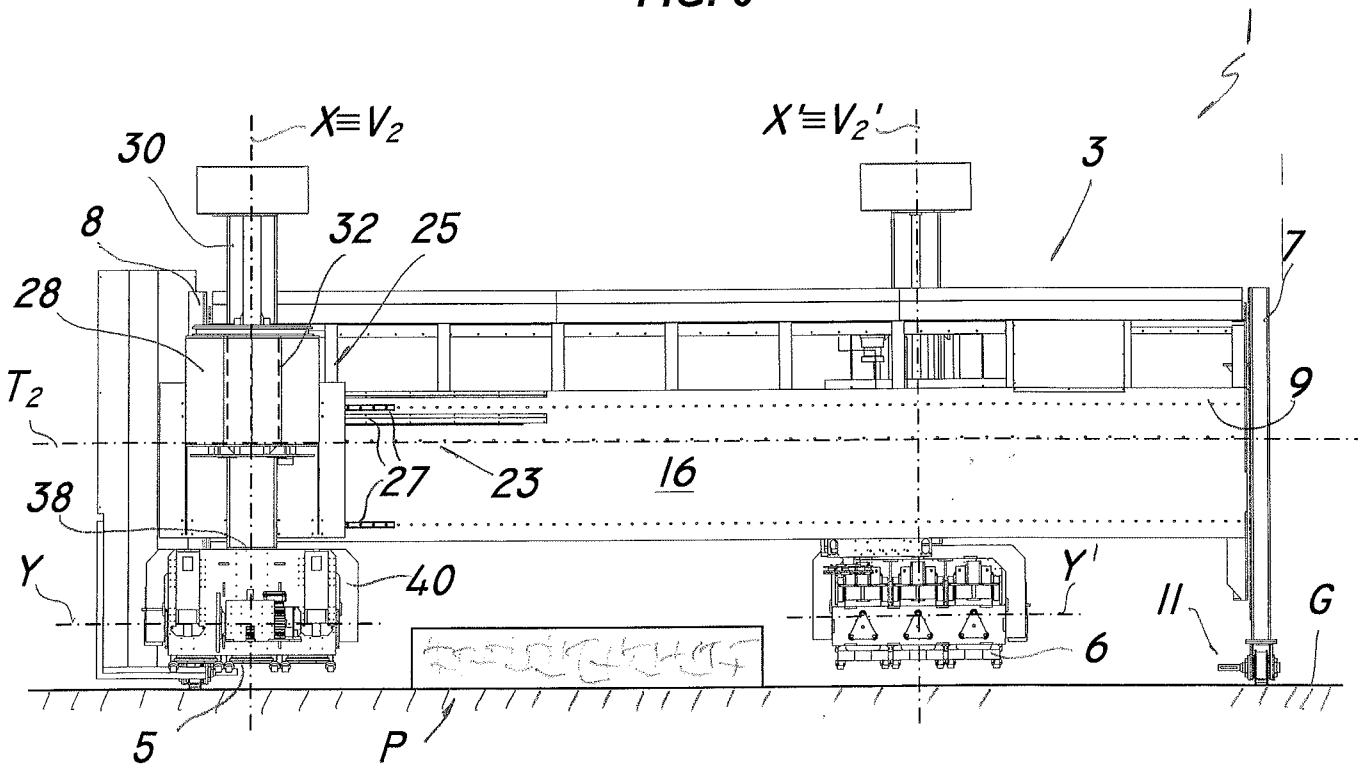
1
X≡V2
X'≡V2'
30
3
8
32
25
7
28
T2
9
27
23
16
38
Y
40
Y'
11
G
6
5
P

FIG. 7

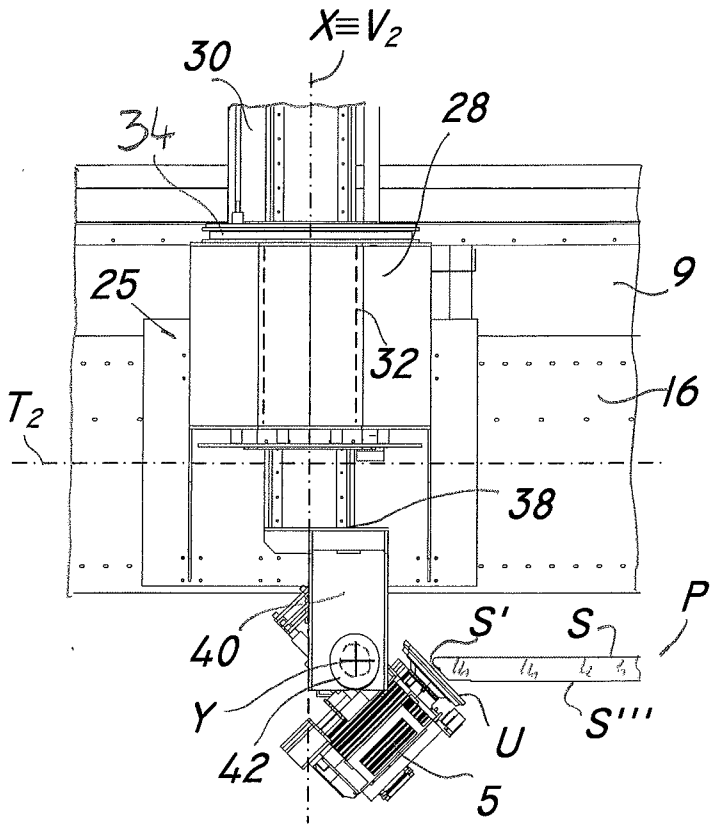


FIG. 8

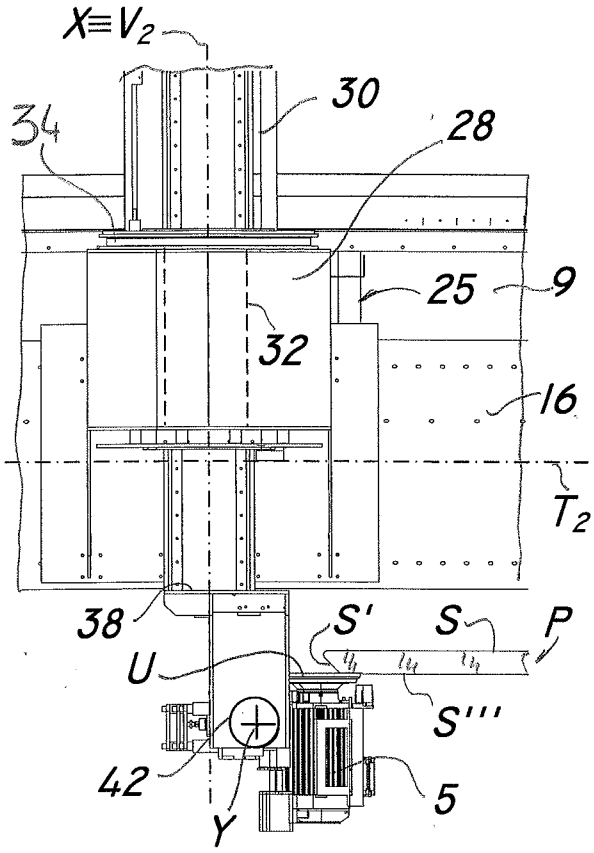


FIG. 9

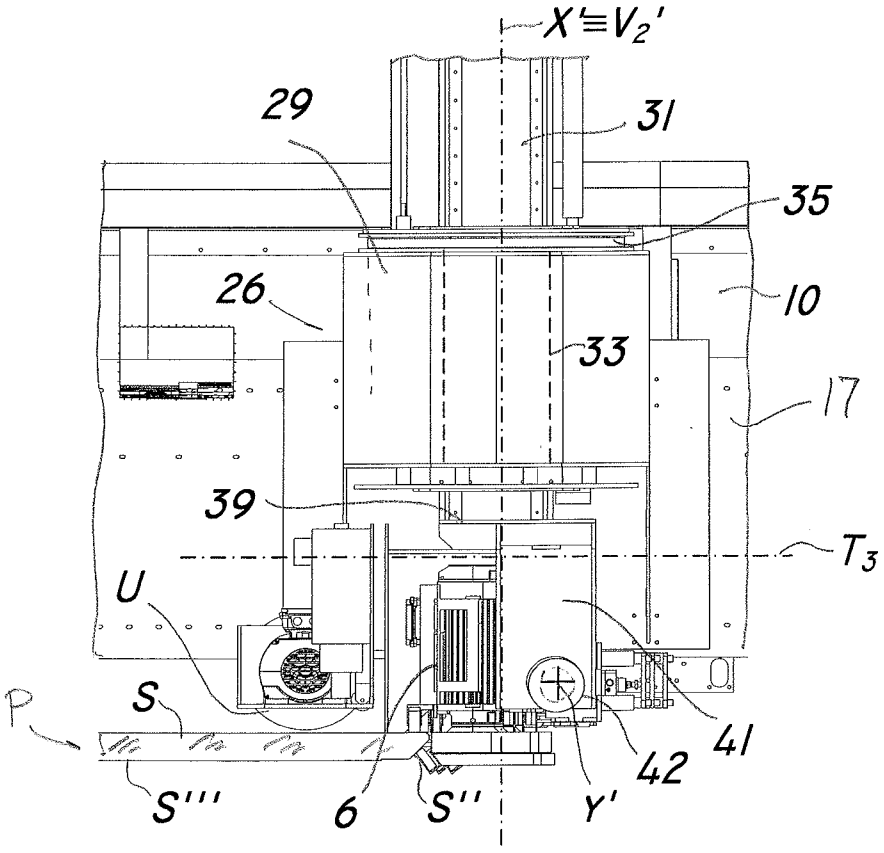


FIG. 10

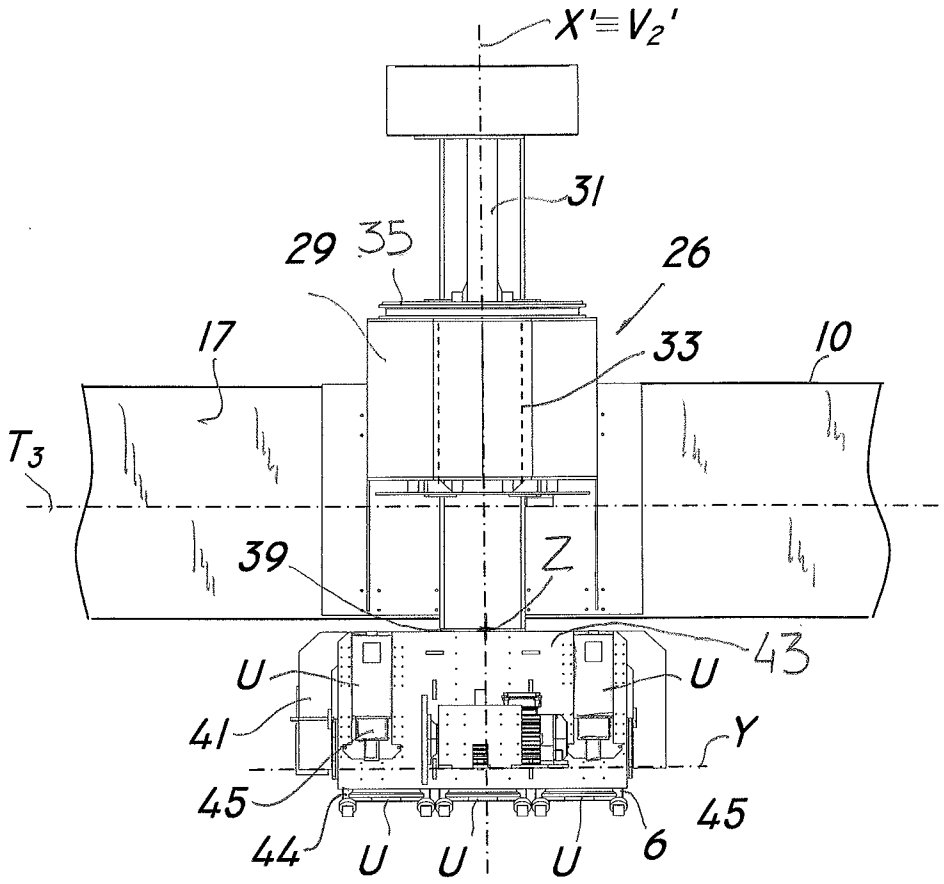
X'≡V2'
31
29
35
26
17
33
10
T3
39
Z
43
U
U
41
Y
45
45
44
U
U
U
6

FIG. 11

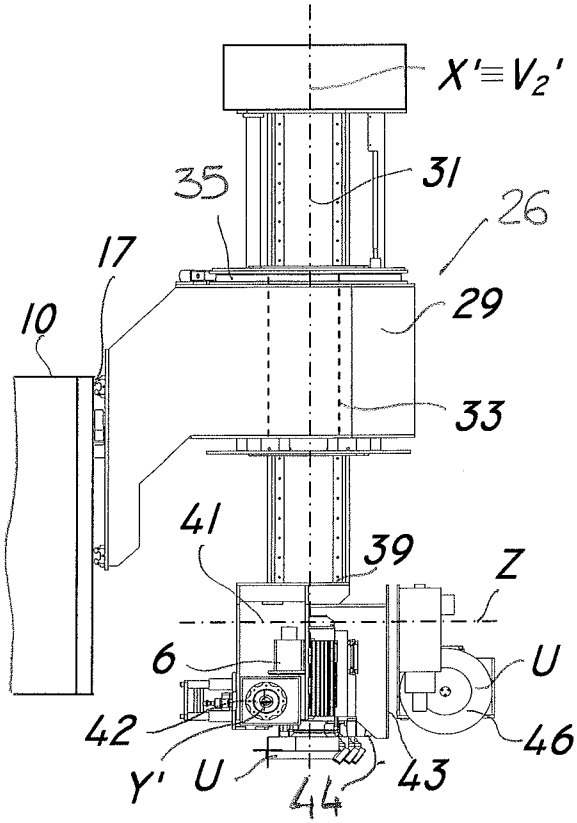
X'≡V2'
35
31
26
17
29
10
33
41
39
Z
6
U
42
46
Y'
U
43
44

FIG. 12

# INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/058640

A. CLASSIFICATION OF SUBJECT MATTER
INV. B28D1/00 B24B7/22 B28D1/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B28D B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | FR 2 694 720 A1 (THIBAUT SA [FR])<br>18 February 1994 (1994-02-18)<br>cited in the application | 1,2,4,12 |
| A | page 1, lines 28-31<br>page 2, lines 12-14<br>page 3, line 30 - page 4, line 12<br>page 6, lines 29-35<br>figures 2-4 | 3 |
| | ----- | |
| A | DE 244 293 C (M. WOODS, G. WASHINGTON, J LITTLE) 2 June 1912 (1912-06-02)<br>page 2, line 35 - page 4, line 86<br>figures 1,4 | 1,2,4,12 |
| | ----- | |
| A | US 1 909 001 A (NELSON ARTHUR E)<br>16 May 1933 (1933-05-16)<br>page 1, lines 60-71<br>pages 1,1,2,; figures 1,2,10-15 | 1,3 |
| | ----- | |
| | -/-- | |

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 8 April 2014 | 17/04/2014 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Chariot, David |

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# INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/058640

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | DE 88 14 459 U1 (R. PLICKERT, B. PLICKERT)<br>22 March 1990 (1990-03-22)<br>page 4, paragraph 1<br>figures 1,2<br>----- | 1 |
| A | WO 2007/072464 A2 (TONCELLI LUCA [IT])<br>28 June 2007 (2007-06-28)<br>page 1, lines 5,6<br>page 3, lines 8-16<br>page 5, line 27 - page 6, line 3<br>figures<br>----- | 1 |

1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/058640

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| FR 2694720 A1 | 18-02-1994 | NONE | |
| DE 244293 C | 02-06-1912 | NONE | |
| US 1909001 A | 16-05-1933 | NONE | |
| DE 8814459 U1 | 22-03-1990 | NONE | |
| WO 2007072464 A2 | 28-06-2007 | AT 477901 T | 15-09-2010 |
| | | EP 1963065 A2 | 03-09-2008 |
| | | ES 2349673 T3 | 10-01-2011 |
| | | PT 1963065 E | 21-10-2010 |
| | | WO 2007072464 A2 | 28-06-2007 |